B 239/987

Preprint from the 1987

BUREAU OF MINES MINERALS YEARBOOK

Barite

UNITED STATES DEPARTMENT OF THE INTERIOR

I 28.37/a:

UNITED STATES DEPARTMENT OF THE INTERIOR • Manuel J. Lujan, Jr., Secretary

BUREAU OF MINES • T S Ary, Director

This publication is a chapter from the current Bureau of Mines Minerals Yearbook, comprising *Volume I, Metals and Minerals; Volume II, Area Reports: Domestic; Volume III, Area Reports: International.* The separate volumes of the Yearbook are sold by the Superintendent of Documents, Washington, D.C. 20402.

Barite

By Sarkis G. Ampian[1]

Domestic production of barite increased more than 50%, reversing the downtrend that started in 1982, and, with the exception of 1984, has persisted ever since. Production from Nevada, the leading producer, increased about 13%. Imports for consumption of crude barite increased 11%, while ground barite imports decreased nearly 50%. Imports of barite exceeded domestic production for the sixth straight year; the import figure of 825,000 short tons for 1987 was nearly 1.6 million tons below the record-high tonnage imported during 1982. Ground barite imports, except for the drilling boom years of the late 1970's and early 1980's, were negligible. The principal use for barite, as a weighting agent in oil- and gas-well-drilling fluids (muds), accounted for 90% of U.S. consumption. Chemicals, glass, and filler and/or extender uses accounted for the remaining 10%.

Demand for barite by the oil- and gas-well-drilling industry, rebounded at mid-year, owing to the firming of oil prices and improvements in the overall economy. The upturn also has been in large part due to the increase in offshore drilling, which tends to have deeper wells that consume more barite than the shallower wells, and to optimism in the oil-producing States. U.S. mine production continued, although still depressed, encouraged by regional sales and declining rail rates, which increased the competitiveness of domestic ores in the gulf coast and midcontinent areas. Barite grinding capacity, despite numerous closures, mergers, and acquisitions, continued to be in a position to meet present and future requirements.

Domestic Data Coverage.—Domestic production data for barite are developed by the Bureau of Mines from one voluntary survey of U.S. operations. Of the 64 operations to which a survey request was sent, all responded, representing 100% of the total crushed and ground production sold or used shown in table 1.

Table 1.—Salient barite and barium chemical statistics

(Thousand short tons and thousand dollars)

	1983	1984	1985	1986	1987
United States:					
Barite, primary:					
Sold or used by producers	754	779	739	297	448
Value	$29,293	$25,445	$21,501	$12,326	$15,810
Exports	23	1	6	7	9
Value	$3,514	$674	$692	$1,021	$716
Imports for consumption (crude)	1,866	1,731	2,056	745	825
Consumption, apparent[1]	2,127	2,505	2,789	1,035	1,264
Crushed and ground (sold or used by processors)[2]	2,745	2,883	2,184	1,216	1,434
Value	$194,880	$220,806	$154,463	$75,965	$108,759
Barium chemicals (sold or used by processors)	22	26	24	25	28
Value	$16,860	$17,105	$16,036	$16,871	$16,466
World: Production	5,924	r6,404	6,649	p5,204	e5,137

eEstimated. pPreliminary. rRevised.
[1]Sold or used plus imports minus exports.
[2]Includes imports.

DOMESTIC PRODUCTION

The term "primary barite" denotes the first marketable product and includes crude run-of-mine barite, flotation concentrates, and material concentrated by other beneficiated processing such as washing, jigging, or magnetic separation. Run-of-mine barite, the lowest cost primary barite sold or used by producers, represented 54% of total production compared with 36% in 1986; the other 46% was flotation concentrate and other beneficiated material. The lower cost crude barite was used chiefly in drilling muds; the higher valued floated and other beneficiated material was used mostly in chemical and glass manufacturing and in filler applications.

Reported primary production increased more than 50%. Nevada and Georgia remained the two leading barite-producing States. Other producing States, in descending order, were Missouri, California, and Montana. All domestic barite production is a primary product. Barite was formerly produced as a coproduct of fluorspar mining and milling in Illinois.

The leading domestic barite producers were M-I Drilling Fluids Co., a Dresser Halliburton Co.; FMC Corp.; Milpark Drilling Fluids, a Baker Hughes Inc. company, with mines in Nevada; and NL Baroid, a division of NL Petroleum Services Inc., with mines in Missouri and Nevada.

The domestic barite industry recovered at midyear, primarily owing to an increase in both oil- and gas-well-drilling activity and the overall economy. The rebound in oil prices, which firmed and even tended to move upwards, was largely responsible for the increase in barite demand. This upturn reversed the trend of declining barite production rates that has been prevalent since 1981, the record-high production year (2.8 million tons). Production data also revealed that a number of factors enabled modest increases in domestic mining campaigns. Those factors included an upturn in drilling activity, competitive rail rates to the gulf coast and midcontinent areas based on unit-trains, and guaranteed-tonnage contracts, coupled with optimism in the oil-producing States.

Nevertheless, the persistent oil glut and lower energy rates, exacerbated primarily by Mideast overproduction, continued to temper or limit any major upturn in oil- and gas-well-drilling activity. Another factor, other than oil prices, depressing the domestic marketplace is the overcapacity in the drilling fluids business. In addition, rising ocean freight rates, in part due to

Table 2.—U.S. primary barite sold or used by producers, by State

State	Number of operations	Run of mine		Flotation concentrates		Beneficiated material[1]		Total[2]	
		Quantity (thousand short tons)	Value (thousands)	Quantity (thousand short tons)	Value (thousands)	Quantity (thousand short tons)	Value (thousands)	Quantity (thousand short tons)	Value (thousands)
1986									
Georgia	2			W	W	W	W	W	W
Missouri	3			W	W	W	W	W	W
Nevada	7	[3]107	[3]1,865			82	$1,522	[3]189	[3]3,387
Tennessee	1	[4]W	[4]W					[4]W	[4]W
Total	13	107	1,865	W	W	[5]190	[5]10,462	[5]297	[5]12,326
1987									
California	1	W	W					W	W
Georgia	2			W	W	W	W	W	W
Missouri	3					W	W	W	W
Montana	1	W	W					W	W
Nevada	7	214	3,249	W	W	W	W	214	3,249
Tennessee	1	W	W					W	W
Total	15	[3]244	[3]7,515	[5]61	[3]$5,238	[5]142	[5]6,300	[5]448	[5]15,810

W Withheld to avoid disclosing company proprietary data.
[1]Includes some flotation concentrates (1986).
[2]Data may not add to totals shown because of independent rounding.
[3]Includes Tennessee.
[4]Included with Nevada.
[5]Includes data indicated by symbol W.

higher bunker fuel costs and limited availability of bottoms, helped make domestic ores more competitive with foreign ores. The firming domestic market, still the world's largest, has turned relatively soft markets into a mild seller's market for both producers and grinders alike. The domestic industry, however, continued to be threatened by imports of crude and ground barite, furthering the risk of a volatile marketplace. Such a scenario could further impact the slowly recovering domestic industry.

Most mining and grinding operations continued to be either suspended or on minimal production schedules to address the industry's overcapacity. Many of the additions to mining, milling, and grinding capacity were largely to reduce operations costs to remain competitive in a firming but volatile market situation. Many ongoing and planned projects, including exploration programs, for the most part have been indefinitely deferred.

Table 3.—Producers of barium materials in 1987

Company	Plant location	Material
BARITE MATERIALS		
American Minerals Inc	Camden, NJ	Well drilling and filler.
Do	El Paso, TX	Do.
Do	Rosiclare, IL	Do.
Circle A Construction Co. Inc	Wells, NV	Primary and filler.
Clark Minerals Inc	South Plainfield, NJ	Filler.
Custom Milling & Supply Co	Salt Lake City, UT	Well drilling.
Cyprus Industrial Minerals Co	Cartersville, GA	Primary and ground.
De Soto Mining Co Inc	Richwoods, MO	Primary.
Dyna Material Inc	Pecos, TX	Well drilling.
Extender Products Ltd	Mineral Point, MO	Filler.
General Barite Co	Washington, MO	Primary.
GEO International Inc	Nevada City, CA	Do.
Industrial Chemicals Div., FMC Corp	Battle Mountain, NV	Do.
Industrial Minerals Co	Florin, CA	Filler.
International Drilling Fluids	Amelia, TX	Well drilling.
M-I Drilling Fluids Co	Battle Mountain, NV	Do.
Do	Brownsville, TX	Well drilling and filler.
Do	Galveston, TX	Well drilling.
Do	Houma, LA	Do.
Do	Houston, TX	Do.
Do	Lander, NV	Primary and ground.
Do	New Orleans, LA	Well drilling.
Do	West Lake Charles, LA	Well drilling and filler.
Milpark Drilling Fluids	Argenta, NV	Primary and ground.
Do	Clinton, OK	Well drilling.
Do	Corpus Christi, TX	Do.
Do	Galveston, TX	Do.
Do	New Orleans, LA	Do.
The Milwhite Co. Inc	Brownsville, TX	Well drilling and filler.
Do	Bryant, AK	Do.
Do	Chatsworth, GA	Ground.
Do	Houston, TX	Well drilling and filler.
Do	Morgan City, LA	Well drilling.
Minerals, Pigments & Metals Div., Pfizer Inc	East St. Louis, IL	Filler.
Mountain Minerals Co. Ltd	Missoula, MT	Primary and ground.
New Riverside Ochre Co	Cartersville, GA	Primary.
NL Baroid	Battle Mountain, NV	Do.
Do	Dunphy, NV	Well drilling.
Do	Fountain Farm, MO	Do.
Do	Lake Charles, LA	Do.
Do	New Orleans, LA	Do.
Do	Potosi, MO	Primary.
Old Soldiers Minerals Ltd	Abbeville, LA	Well drilling.
Do	Elk County, OK	Do.
Ozark Mahoning Co	Rosiclare, IL	Primary.
A. J. Smith Co. Inc	Sweetwater, TN	Primary and ground.
Standard Industrial Minerals	Laws, CA	Filler.
Standard Slag Co	Churchill, NV	Primary.
Do	Nye, NV	Do.
BARIUM COMPOUNDS		
J. T. Baker Chemical Co	Phillipsburg, NJ	Chemicals.
Chemical Products Corp	Cartersville, GA	Do.
Mallinckrodt Inc., a subsidiary of FMC Corp	St. Louis, MO	Do.

Baker Hughes Inc., formed from Baker International Corp. and Hughes Tool Co., purchased the remaining interest in Hughes Drilling Fluids, held by W. R. Grace Co. These operations have been further combined with Milchem Inc., a former unit of Baker International, to form one of the largest drilling fluids companies in the world. NL Industries Inc. adopted a tentative plan to spinoff its oilfield services business, NL Petroleum, to shareholders. NL Baroid barite and clay-producing and grinding facilities will be operated as part of a separate division. In a reorganization, Cyprus Minerals Co. Inc. announced plans to merge four groups of its industrial minerals division into a single unit. Presently, Cyprus Industrial Minerals Co. has three operating companies, one of which mines and produces filler- and extender-grade barite. In a barium chemical action, International Minerals & Chemical Corp. announced that its Mallinckrodt Inc. unit was planning to divest its chemical line for barium gastrointestinal imaging products manufactured in St. Louis, MO.

The U.S. Department of Commerce and the U.S. International Trade Commission responded to a request by a petitioner, Chemical Products Corp., Cartersville, GA, for an antidumping duty administrative review of barium chemicals from China[2] and the Federal Republic of Germany.[3]

The final results of one of the Chinese antidumping reviews covered China National Chemicals Import and Export Corp. (Sinochem), a manufacturer and exporter of barium chloride to the United States, for the period October 1, 1984 through September 30, 1985. The review determined a margin of 7.82% existed for Sinochem for the above period. The Department of Commerce instructed the Customs Service to assess antidumping duties of 7.82% on all appropriate entries. For any future entries of this chemical for a new exporter not covered in this final review, whose shipments occurred after September 30, 1985, a cash deposit of 7.82% was required. The deposit requirement was effective for all shipments of Chinese barium chloride entered or withdrawn from warehouse, and for consumption on or after the date of publication of these final results. Initiation of antidumping countervailing duty administrative reviews were also planned for Sinochem barium chloride imported between October 1, 1986, and September 30, 1987.[4] A similar preliminary study on an antidumping duty administrative review of precipitated barium carbonate from the Federal Republic of Germany indicated the existence of no dumping margins for the firm Kali-Chemie AG, for the period July 1, 1985, through June 30, 1986. For any shipments from the one remaining Chinese manufacturer and/or exporter not covered by this review, the cash deposit will continue to be the rate published in the final result of the last administrative review for that firm (April 2, 1985).

CONSUMPTION AND USES

Consumption of crushed and ground barite increased nearly 18% from 1.2 million tons in 1986 to 1.4 million tons in 1987. This upturn, except for small increase in 1984, reversed the decline in total barite consumption prevalent since 1981, when the record high of 4.7 million tons of crushed and ground barite was set. This increase not only reflects an upturn in barite requirements for oil well drilling, which still accounts for more than 90% of total sales, but also in the overall economy. The oil- and gas-well-drilling industry completed more than 26,000 wells and drilled nearly 125 million feet of hole;[5] both figures were approximately 15% lower than in 1986.

Total well footage drilled exceeded 8 million feet in four States: Texas, 47.5; Oklahoma, 15.6; Louisiana, 13.4; and Kansas, 8.3. Generally, the deeper a hole is drilled, the more barite is used per foot of drilling. Among the four leading States, Louisiana had the greatest average well depth, nearly 6,800 feet, and Kansas, the shallowest, about 3,300 feet. Wyoming, absent from the top States this year in well footage drilled, again had the greatest average well depth of nearly 7,000 feet. The U.S. average increased to nearly 4,800 feet. The main reason that barite consumption increased, despite the 15% reduction in the number of wells drilled, was the upturn in operating offshore rigs in the Gulf of Mexico and in California at the expense of the shallower drilling, onshore varieties. These offshore wells, the Overthrust Belt in Wyoming, and the Anadarko Basin in Oklahoma are all deep-drilling areas. This increase was accompanied by an increase in the amount of barite used per foot of drilling to 20.7

pounds from 15.0 pounds in 1986.

Another barometer of drilling activity, the Baker Hughes rig count, showed the average number of operating domestic rigs decreased 3% to 936 rigs.[6] This slight decrease in rigs continued a downward trend that, except for 1984, has seen the number of rigs fall from the 1981 record high of 3,974. The 1987 average rig count of 936 is the second time since 1971 (976 rigs) that the count was under 1,000. The estimated rig count during the year ranged from 744 to 1,181. The low rig count of 744, recorded the week of May 16, 1987, was the second lowest since World War II. The high, 1,181 rigs, was registered the week of December 12, 1987.

Table 4.—Crushed and ground barite[1] sold or used by processors in the United States, by State

State	1986			1987		
	Number of plants	Quantity (thousand short tons)	Value (thousands)	Number of plants	Quantity (thousand short tons)	Value (thousands)
Louisiana	9	585	$38,215	8	721	$47,133
Missouri	3	18	752	2	W	W
Nevada	4	101	2,523	3	236	14,939
Oklahoma	3	38	2,140	2	W	W
Texas	11	361	19,703	8	301	22,230
Other[2]	12	111	12,632	16	179	24,457
Total[3]	42	1,216	75,965	39	1,434	108,759

W Withheld to avoid disclosing company proprietary data.
[1]Includes imports.
[2]Includes Arkansas, California, Georgia, Illinois, Missouri (1987), New Jersey, New York, Oklahoma (1987), Tennessee, and Utah.
[3]Data may not add to totals shown because of independent rounding.

Table 5.—Crushed and ground barite[1] sold or used by processors in the United States, by use

(Thousand short tons and thousand dollars)

Use	1986		1987	
	Quantity	Value	Quantity	Value
Barium chemicals, filler and/or extender, glass	119	13,707	141	22,419
Well drilling	1,097	62,258	1,294	86,340
Total	1,216	75,965	[2]1,434	108,759

[1]Includes imports.
[2]Data do not add to total shown because of independent rounding.

Table 6.—U.S. barium chemicals[1] produced and sold or used by processors

Barium chemical	1986				1987			
	Plants[2]	Production (short tons)	Sold or used by processors		Plants[2]	Production (short tons)	Sold or used by processors	
			Quantity (short tons)	Value (thousands)			Quantity (short tons)	Value (thousands)
Barium acetate	1	W	W	W	1	W	W	W
Barium carbonate	2	W	W	W	2	W	W	W
Barium chloride	2	W	W	W	2	W	W	W
Barium nitrate	1	W	W	W	1	W	W	W
Barium sulfide, gray	1	W	W	W	1	W	W	W
Black ash	1	W	W	W	1	W	W	W
Blanc fixe	1	W	W	W	1	W	W	W
Total	3	26,075	25,446	$16,871	3	28,447	28,008	$16,466

W Withheld to avoid disclosing company proprietary data.
[1]Data reported by plants that consume either barite or precursors are included.
[2]A plant producing more than 1 product is counted only once.

Table 7.—U.S. hydrocarbon well drilling and barite consumption

Year	Barite used for well drilling (thousand short tons)	Wells drilled (thousands)[1]				Successful wells (percent)	Average depth per well (feet)	Average barite per well (short tons)
		Oil	Gas	Dry holes	Total			
1967	965	15.33	3.66	13.23	32.22	58.9	4,365	29.95
1968	1,006	14.33	3.46	12.81	30.60	58.1	4,738	32.88
1969	1,235	14.77	4.09	13.74	32.19	57.3	4,881	38.37
1970	1,119	13.02	3.84	11.26	28.12	60.0	4,952	39.79
1971	1,044	11.86	3.83	10.16	25.85	60.7	4,806	40.39
1972	1,163	11.31	4.93	11.06	27.30	59.5	4,932	43.33
1973	1,326	9.90	6.29	10.31	26.60	61.2	5,129	49.85
1974	1,449	12.78	7.24	11.67	31.69	63.2	4,750	45.44
1975	1,638	16.41	7.58	13.25	37.24	64.4	4,685	43.98
1976	1,986	17.06	9.09	13.62	39.77	65.7	4,571	49.94
1977	2,372	18.91	11.38	14.69	44.98	67.3	4,687	52.74
1978	2,632	17.76	12.93	16.25	46.94	65.4	4,829	56.07
1979	2,967	19.28	14.68	15.73	49.81	68.4	4,791	59.57
1980	3,365	26.99	15.74	18.09	60.82	70.3	4,673	55.66
1981	4,526	37.67	17.89	22.97	78.53	70.8	4,602	57.63
1982	4,048	40.30	18.95	26.55	85.80	69.1	4,616	47.18
1983	2,648	37.21	15.63	23.49	76.33	69.2	4,268	34.69
1984	2,695	41.10	15.71	25.23	82.04	69.5	4,246	32.85
1985	2,042	26.24	10.15	15.97	52.36	69.5	4,658	39.00
1986	1,097	15.27	5.53	10.28	31.08	66.9	4,716	35.30
1987	1,294	12.13	4.97	9.04	26.14	65.4	4,779	49.50

[1]Includes exploratory and development wells; excludes service wells, stratigraphic tests, and core tests.

Source: American Petroleum Institute.

PRICES

Price quotations in trade publications for barite remained unchanged. These prices may serve as a general guide but do not reflect actual transactions.

The reported average value per ton of domestic barite, based on reported value or direct-ship, beneficiated, and floated material, decreased slightly, f.o.b. plant, from $41.50 per ton in 1986 to $35.29. This decline in value for domestic concentrate was attributed to a greater percentage of lower valued drilling-mud-grade material in the total. The average reported value per ton of ground drilling-mud-grade barite from Louisiana and Texas was $67.90; the average value of that from California, Nevada, and Utah was $62.76. The value of the Louisiana and Texas ground material, in direct response to steadily improving market conditions, rose about 11%. Material from the other major grinding States, supplied largely by domestic mines, declined slightly. The average customs value of barite exported to Canada and Mexico was about $325 per ton; the customs value of material exported to Latin America was about $100 per ton.

Table 8.—Barite price quotations

Item	Price per short ton[1]	
	1986	1987
Barite[2]		
Chemical, filler, glass grades, f.o.b. shipping point, carlots:		
Handpicked, 95% $BaSO_4$, not over 1% Fe	$90.00	$80.00
Magnetic or flotation, 96% to 98% $BaSO_4$, not over 0.5% Fe	106.00	116.00
Water-ground, 95% $BaSO_4$, 325 mesh, 50-pound bags	$70.00-165.00	$70.00-165.00
Drilling-mud grade:		
Dry-ground, 85% to 93% $BaSO_4$, 3% to 12% Fe, specific gravity 4.20 to 4.30, f.o.b. shipping point, carlots	60.00-90.00	60.00-90.00
Crude, imported, specific gravity 4.20 to 4.30, f.o.b. shipping point	40.00-55.00	40.00-55.00
Barium chemicals[3]		
Barium carbonate:		
Precipitated, bulk, carlots, freight equalized (per pound)	.25	.25
Electronics-grade, bags	510.00	510.00
Barium chloride:		
Technical crystals, bags, carlots, works	470.00	470.00
Anhydrous, bags, carlots, same basis	506.00	506.00
Barium hydrate: Mono, 55-pound bags, carlots, delivered (100 pounds)	46.00	46.00
Barium sulfate:		
Blanc fixe, technical-grade, bags, carlots	400.00	400.00
U.S.P., X-ray diagnosis-grade, powder, 25-kilogram bags, 10,000-kilogram lots (per pound)	.55	.55
Barium sulfide (black ash), drums, carlots, works	460.00	460.00

[1]Unless otherwise specified.
[2]Engineering and Mining Journal, V. 187, No. 12, Dec. 1986, p. 19, and v. 188, No. 12, Dec. 1987, p. 27.
[3]Chemical Marketing Reporter, V. 230, No. 26, Dec. 29, 1986, pp. 24-25, and v. 232, No. 26, Dec. 28, 1987, pp. 28-29.

FOREIGN TRADE

Exports of natural barium sulfate or barite increased about 30% from nearly 7,000 tons to more than 9,000 tons. This represented a third year increases in exports after 6 consecutive years of decline from the record high of 1979 when 109,000 tons was exported. Export and import data provided by the Bureau of the Census did not indicate the grades of barite traded; however, based on the value of individual shipments, an estimated 97% was ground drilling-mud grade, and the remaining 3% was chemical-, filler-, or glass-grade. Minor amounts of witherite (natural barium carbonate), precipitated barium carbonate, and sulfate were also exported. Crude barite was not exported. Canada and Mexico, traditionally either first or second among export recipients, were buyers of U.S. ground barite. Those two countries consumed about 89% of the total exports. Canada and Mexico received only about 2% of the total. Exports to Mexico, a major oil-producing country, declined to only 13 tons from a high of 18,000 tons in 1983. Both Canada and Mexico continued to rely more on domestic production. During the year, the weakening U.S. dollar had little effect on trade because of continuing Canadian and Mexican financial or economic problems.

Imports for consumption of crude barite increased 11% from 745,000 tons in 1986 to more than 825,000 tons. The 1987 barite import figure was nearly 65% below the record high of 2.32 million tons set in 1982. The c.i.f.[1] value of this material dropped 9% to $32.91 per ton, indicating that prices of foreign ores continued to decline in response to oversupply and lower ocean shipping rates. At yearend, an earlier cutback in foreign production, notably in China and India, due to an absence of forward commitments, saw a firming of both crude barite prices and shipping rates. Shipping rates were influenced, in part, because the abrogated charters for barite were unavailable at previous rates during the yearend upturn because of more profitable competing foodstuff cargoes such as wheat. Domestic producers and consumers, faced with relatively high rail rates to ship from domestic drilling-quality barite mines in Nevada to gulf coast-area grinding plants, continued to take advantage of the lower priced for-

eign ores to meet their demands in this highly competitive gulf coast area. Based on an average value per ton of material shipped, the principal source countries, in descending order, were Mexico, India, Morocco, and China.

The high-priced Mexican material was chiefly crude filler- and extender-quality barite. The costlier high-quality barite, generally material with a specific gravity greater than 4.2, is usually blended with lower grade ore, foreign or domestic, during grinding to meet American Petroleum Institute specifications for 4.2-drilling-mud-grade barite. Crude barite, for the most part, entered through customs districts near most drilling-mud markets along the gulf coast for delivery to grinding plants in the area. The import distribution by customs districts in 1987 (1986) was New Orleans, LA, 68% (58%); Houston, TX, 21% (34%); and Laredo, TX (Port of Brownsville, TX), 11% (8%). Small amounts were also received, in decreasing amounts, in Great Falls, MT, and Detroit, MI.

Imports for consumption of ground barite decreased about 50% to more than 11,000 tons from nearly 22,000 tons in 1986; of this, Canada and Mexico supplied about 80%. Prior to 1984, ground barite imports had been limited to premium-quality pharmaceutical grades, which were unavailable domestically. In recent years, this market has been dwindling because certain medical X-ray diagnostic procedures employing barium compounds have been largely replaced with computer-assisted tomography (CAT) scanners or imaging techniques. Sources of medical-grade barite were Belgium-Luxembourg, Canada, France, the Federal Republic of Germany, and the Netherlands. Prices averaged $1,500 per ton. The average c.i.f. value of Moroccan imports, $115 per ton, suggested that this barite was probably drilling-mud-grade material. The increase in imports of mud-grade ground barite noted during the last 4 years appears to be ending because of increasing competition from domestic grinders in both price and quality. The continued imports of ground drilling-mud-grade barite, in a slowly recovering market situation, will probably hamper the recovery at the grinding plants and domestic mines that still can supply ore for blending. The value of imports from other countries, about $300 per ton, indicated that this ground material was probably destined for the domestic filler and/or extender markets that usually are supplied by U.S. producers.

Imports for consumpton of barium chemicals and unwrought and/or waste and scrap barium metal, for the most part, increased in quantity and value.

Table 9.—U.S. exports of natural barium sulfate, by country

Country	1986		1987	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
Argentina	80	$42	85	$37
Canada	878	284	196	194
Chile	1,950	178		
Ecuador			508	46
Mexico	53	27	13	6
Nigeria			1,655	147
Paraguay			150	14
Philippines	23	12	3	3
Venezuela	3,787	192	6,386	249
Zaire			85	9
Other	199	285	1	11
Total[1]	6,969	1,021	9,083	716

[1]Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

Table 10.—U.S. imports for consumption of barite, by country

Country	1986		1987	
	Quantity (short tons)	Value[1] (thousands)	Quantity (short tons)	Value[1] (thousands)
Crude barite:				
Canada			100	$7
Chile	79,249	$677	—	—
China	429,196	15,019	636,336	20,487
India	118,685	4,419	56,520	1,861
Ireland	12,731	224	—	—
Mexico	34,945	1,314	75,405	2,812
Morocco	81,963	2,862	36,890	1,393
Thailand	39,906	1,430	—	—
Other	3,163	225	—	—
Total[2]	744,946	26,369	925,251	27,162
Ground barite:				
Belgium-Luxembourg	—	—	22	*
Canada	5,919	960	8,480	1,751
China	273	32	—	—
France	102	30	456	121
Germany, Federal Republic of	436	196	296	85
Mexico	237	4	—	—
Morocco	12,457	687	1,389	184
Netherlands	194	70	526	198
Thailand	3,126	358	—	—
Other	1	2	44	10
Total[2]	21,845	2,499	11,333	2,857

[1]C.i.f. value.
[2]Data may not add to totals shown because of independent rounding.

Source: Bureau of the Census.

Table 11.—U.S. imports for consumption of barium chemicals

Year	Lithopone		Blanc fixe (precipitated barium sulfate)		Barium chloride		Barium hydroxide	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1983	NA	NA	9,087	$5,911	2,402	$1,016	4,799	$3,751
1984	NA	NA	9,302	6,361	3,680	1,576	5,432	3,973
1985	NA	NA	8,971	6,295	2,839	1,125	5,708	3,959
1986	NA	NA	10,449	8,530	1,919	733	4,925	3,960
1987	NA	NA	11,479	8,586	1,979	775	5,247	4,147

Year	Barium nitrate		Barium carbonate, precipitated		Other barium compounds	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1983	777	$275	8,821	$3,884	946	$1,256
1984	1,278	478	14,476	7,269	1,020	847
1985	1,339	643	12,437	5,400	1,593	2,566
1986	1,143	561	11,365	4,809	1,802	3,197
1987	1,459	579	12,851	5,485	9,442	2,500

NA Not available.

Source: Bureau of the Census.

Table 12.—U.S. imports for consumption of crude, unground, and crushed or ground witherite[1]

Year	Crude, unground		Crushed or ground	
	Quantity (short tons)	Value (thousands)	Quantity (short tons)	Value (thousands)
1983	1	$1	87	$12
1984	4	2	59	7
1985	1	1	111	10
1986	2	1	143	10
1987	264	67	72	8

[1]Barium carbonate.

Source: Bureau of the Census.

WORLD REVIEW

Australia.—The main barite workings were centered around the underground mines of Commercial Minerals Ltd. at Oraparinna, approximately 300 miles north of Adelaide in the Flinders Ranges of South Australia.[8] The ore lies within steeply dipping veins up to 5 meters in width, hosted by purple slates and shales. The Oraparinna ore is high grade and marketed chiefly for paint and other industrial uses. Drilling-mud grades were from open pit mines at nearby Dunbar.

India.—The floor prices of specialty whiter grades of barite powders were lowered by Krishnappar Asbestos and Barytes Pvt. Ltd. following consultation with the Government. The new floor prices per metric ton bagged, f.o.b. Madras, were super snow white, $110; snow white, $100; and white, $88. The old floor prices were $165, $155, and $138, respectively. Shipments also incurred a Government fixed price of $8 per metric ton for palletizing.

Korea, Republic of.—Korean Chemical Co., an equal joint venture between France's Rhône-Poulenc S.A. and Oriental Chemical Industry Ltd., received governmental approval to construct a $20 million barium and strontium carbonate plant at Inchon, about 50 miles from Seoul.[9] The plant would have a 22,000-ton-per-year capacity of both carbonates. The strongest markets for these salts were in the manufacture of black and white and color TV tubes and/or envelopes. In another similar project Kali-Chemie, a West German subsidiary of the Solvay Group, and Samsung Corning Co. Ltd., Republic of Korea, agreed to a 50-50 joint venture for additional production of barium and strontium chemicals.[10] The joint venture company, Daehan Specialty Chemicals Co. Ltd., will build a 45,000-ton-per-year production facility on the southeast coast for completion by early 1989. Kali-Chemie is the world's largest producer of barium and strontium compounds while Samsung Corning is a leading television glassmaker.

Mexico.—The decline of national barite production was caused largely by the cutback in oil- and gas-drilling exploration programs by its main customer, Petroleos Mexicanos (PEMEX), in response to depressed worldwide oil prices.[11]

Pakistan.—The Baluchistan Development Authority (BDA) began supplying barite to its new chemical plant at Hub Chanki from its Lasbela District deposits. The plant was to run as a joint venture, Minchem, by BDA (51%) and a private party (49%) with the latter managing and controlling chemical production and BDA supplying the raw materials. Barium chemical production, by the black-ash process, was targeted for about 20,000 tons per year including 3,000 tons per year of lithupone and 3,500 tons per year of barium carbonate, barium nitrate, nonbarium chemicals. A second chemical plant, to be run by the private sector, was to be assembled near Islamabad by midyear. The venture, known as Sihala Chemical Complex, was to consist essentially of an imported Chinese barium chemicals plant and Bolan Mining Enterprises Ltd. (BME). BME was to supplying about 5,000 tons per year of barite to manufacture barium chemicals, some of which were to be exported back to China. Both the process and barium chemicals to be manufactured were unspecified.[12]

Table 13.—Barite: World production, by country[1]

(Thousand short tons)

Country[2]	1983	1984	1985	1986[p]	1987[e]
Afghanistan[e, 3]	2	2	2	2	2
Algeria	[r]120	35	66	66	66
Argentina	67	49	57	65	64
Australia	13	22	25	6	[4]
Belgium[e]	44	43	44	44	44
Bolivia	1	1	1	[4]	2
Brazil	140	158	170	[r, e]165	185
Burma[5]	11	11	9	9	9
Canada	50	32	78	[r, e]44	45
Chile	126	24	60	58	55
China[e]	1,100	1,100	1,100	1,100	1,100
Colombia	4	4	6	5	[6]5
Czechoslovakia[e]	67	60	66	66	66
Egypt[e]	4	6	5	[r]5	5
Finland	4	10	10	6	[6]12
France	159	161	[r]165	[r]160	155
German Democratic Republic[e]	39	39	37	37	35
Germany, Federal Republic of	197	194	189	222	200
Greece[7]	3	3	4	3	3
Guatemala[e]	[4]	[4]	[r]3	[r]2	—
India	350	492	629	379	500
Iran[e]	94	100	100	100	100
Ireland	226	243	206	141	165
Italy	123	114	141	124	125
Japan	72	73	85	58	55
Kenya	[4]	[4]	[4]	[4]	1
Korea, Republic of	1	3	3	4	4
Malaysia	23	28	36	19	44
Mexico	394	470	516	454	[r]445
Morocco	118	619	551	309	[r]158
Pakistan	29	30	33	43	14
Peru	122	31	24	33	33
Philippines	1	1	—	—	—
Poland	83	89	106	108	65
Portugal[e]	[4]	[4]	[4]	[4]	[4]
Romania[e]	86	80	80	80	80
South Africa, Republic of	7	5	5	10	[6]9
Spain	59	70	74	[r]74	75
Thailand	205	130	255	157	[r]57
Tunisia	22	13	[r]22	[r]22	22
Turkey	87	218	183	[r]193	193
U.S.S.R.[e]	570	580	595	595	595
United Kingdom	93	69	118	96	[r]99
United States[e]	754	775	729	297	[r]448
Yugoslavia	39	45	[r]40	[r]40	40
Zimbabwe	1	1	[4]	[4]	[4]
Total	5,957	[r]6,404	6,629	5,204	5,137

[e]Estimated. [p]Preliminary. [r]Revised.

[1]Table includes data available through June 17, 1988.

[2]In addition to the countries listed, Bulgaria also produces barite, but available information was inadequate to make reliable estimates of output levels.

[3]Data are for fiscal year beginning March 21 of that stated.

[4]Less than 1/2 unit.

[5]Data are for fiscal year beginning April 1 of that stated.

[6]Reported figure.

[7]Barite concentrates.

[8]Sold or used by producers.

Turkey.—The Paleozoic formations in Konya, Maraş, Antalya, Kutahya, and Mus Provinces contained the country's major barite deposits.[18] The total mine production capacity was reported to be over 650,000 tons per year with proven reserves at 6 million tons, probable reserves at nearly 9 million tons, and total reserves assumed to be over 25 million tons.

TECHNOLOGY

A remarkable new perovskite-structure material, yttrium-barium-copper oxide ($YBa_2Cu_4O_7$), was synthesized and found to be fully superconductive at about 90 K.[19] This new material, made from relatively inexpensive raw materials, is capable of conducting electricity with virtually no resistance at readily attainable nitrogen tem-

peratures. The crystallography,[15] physical and chemical properties,[16] and the Raman spectroscopy of phases[17] for this superconducting phase and its analogs were discussed. The discovery, long sought by scientists and engineers, should eventually lead to less costly electrical transmission over great distances, miniature computers more powerful than any now in existence, and certainly many other uses not yet conceived. The high-purity requirements for these electroceramics by the electronic and optical glass industries are largely responsible for the worldwide resurgence in barium chemicals manufacturing in general and high-purity salts in particular.

Comprehensive reviews published on the industrial minerals of Australia[18] and Pakistan[19] included detailed sections on barite, local geology, mineralogy, mining and milling flowsheets, and indigenous mining methods. The review of Pakistan included a separate section on the major barite mining and milling companies and their capacities, along with a map pinpointing their locations. The growing Pakistani barium chemicals industry, offsetting the depressed drilling-mud industry, was singled out for special attention.

The mining and geology of the barite deposits of the Alwar District, Rajasthan, India,[20] and the Yugoslav barite industry[21] also were published. The Rajasthan report highlights not only the barite mining and geology of the area but also a case study of a typical underground mine in the district. The mines are in a region where electric power is available only from portable generators. The Yugoslav paper presents a concise review of its domestic barite deposit, methods for barite ore dressing, and the technology for its consumption patterns. A section emphasizing the type of deposits—vein, sedimentary (bedded), or residual—along with geology and mining techniques, and processing, washing, and flotation flowsheets for the Lokve Mine and mill complex were most informative.

Two articles reviewed the uses of mineral fillers and extenders in the growing domestic plastics markets, both resins and thermosets. One paper examined the selected market sectors technically, relating their consumption of mineral fillers in reinforcements and pigments for interior and exterior applications.[22] The role of barite in plastisols for carpet-backing, where it imparts sound-deadening characteristics, in fillers for non-asbestos brake lining as a heat sink, and in polyurethane foam used in furniture manufacture for recoil and density properties was highlighted in a feature section dealing with special applications. The other paper stressed the technical challenge of product modifications by employing selected minerals and surface-modified minerals.[23] The unique chemical inertness of barite in combination with its high density should play a major role in the future design of advanced plastic products.

---

[1]Physical scientist, Branch of Industrial Minerals.

[2]International Trade Administration, Import Administration, U.S. Department of Commerce. Barium Chloride From the People's Republic of China; Final Results of Antidumping Duty Administrative Review. Fed. Regist., v. 52, No. 2, Jan. 5, 1987, pp. 313-315.

[3]———. Precipitated Barium Carbonate From the Federal Republic of Germany; Final Results of Antidumping Duty Administrative Review. Fed. Regist., v. 52, No. 104, June 1, 1987, pp. 20438-20439.

[4]———. Initiation of Antidumping and Countervailing Duty Administrative Reviews. Fed. Regist., v. 52, No. 222, Nov. 18, 1987, p. 44161.

[5]American Petroleum Institute. Quarterly Review of Drilling Statistics for the United States, 4th Quarter, 1987, and Annual Summary, 1987. V. 2, No. 4, Feb. 1987, 98 pp.

[6]Baker Hughes Inc. 1987 Annual Report. 48 pp.

[7]Cost, insurance, and freight.

[8]Clarke, G. Australia's Industrial Minerals: Dynamic and Diverse. Ind. Miner. (London), No. 243, Dec. 1987, pp. 19-45.

[9]Industrial Minerals (London). Mineral Notes: $BaCO_3$, $SrCO_3$ for Far East. No. 235, Apr. 1987, p. 82.

[10]Chemical Marketing Reporter. Kali-Chemie Slates Venture in Korea. V. 232, No. 25, Dec. 12, 1987, p. 4.

[11]U.S. Embassy, Mexico City, Mexico. State Dep. Airgram A-032, Sept. 8, 1987, 41 pp.

[12]Griffiths, J. Pakistan's Mineral Potential: Prince or Pauper. Ind. Miner. (London), No. 238, July 1987, pp. 29-42.

[13]Karayazici, F. Industry Structure, Past, Present, and Future. Pres. at Ind. Miner. Conf., Istanbul, Turkey, Sept. 20-22, 1987, 4 pp.; available upon request from Metal Bulletin Journal Ltd., London, United Kingdom.

[14]Carnegie Institution of Washington. Yearbook 87. Pp. 108-114.

[15]Wong-Ng, W., K. L. Davis, and R. S. Roth. X-Ray Powder Study of 2BaO·CuO. Am. Ceram. Soc. Bull., v. 71, No. 2, Feb. 1988, pp. C64-C67.

Hazen, R. M., L. W. Finger, R. J. Angel, C. T. Prewitt, N. L. Ross, H. K. Mao, C. G. Hadidiacos, P. H. Hor, R. L. Meng, and C. W. Chu. Crystallographic Description of Phases in the Y-Ba-Cu-O Superconductor. Am. Phys. Soc. Bull. Phys. Rev., v. 35, No. 13, May 1, 1987, pp. 7238-7241.

[16]Trolier, S. E., S. D. Atkinson, P. A. Fuierer, J. H. Adair, and R. E. Newnham. Dissolution of $YBa_2Cu_3O_{7-x}$ in Various Solvents. Am. Ceram. Soc. Bull., v. 67, No. 4, Apr. 1988, pp. 759-762.

[17]Hemley, R. J., and H. K. Mao. Single-Crystal Micro-Raman Spectroscopy of Phases in the Y-Ba-Cu-O Superconductor. Am. Phys. Soc., Bull. Phys. Rev. Lett., v. 58, No. 22, June 1, 1987, pp. 2340-2342.

[18]Work cited in footnote 8.

[19]Work cited in footnote 13.

[20]Jain, V. K. Mining and Geology of Barytes Deposit of District Alwar, Rajasthan. Mines, Met. and Fuels (India), v. 35, No. 7, July 1987, pp. 328-330.

[21]Salatic, D., and M. Jelic. Barytes in Yugoslavia—Deposits, Processing and Consumption. Ed. by G. M. Carke. Pres. at Sixth Ind. Miner. Int. Conf., Toronto, Canada, May 21-24, 1984, pp. DS1-DS8; available upon request from Metal Bulletin, London, United Kingdom.

[22]Dickson, T. U.S. Plastics: A Growing Mineral Market. Ind. Miner. (London), No. 233, Feb. 1987, pp. 50-57.

[23]Haskins, R. W. and C. E. Cheat. Minerals in Plastics: Meeting the Challenge of the Future. Ind. Miner. (London), No. 234, Mar. 1987, pp. 54-59.

☆ U.S. GOVERNMENT PRINTING OFFICE: 1989—242-377 80066